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POSTURE TRAINING PROGRAM FOR SECONDARY SPECIAL NEEDS STUDENTS

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to the Educational Research Institute of B.C.

POSTURE TRAINING PROGRAM
FOR SECONDARY SPECIAL NEEDS STUDENTS

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ABSTRACT

Teaching mentally handicapped adolescents skills that aid in the development of posture is important for the transition to the world of work. The high incidence of postural abnormalities in the secondary special needs students examined suggests the need for comprehensive posture screening procedures. The Trotter Kinetic Posture Rating System and Arlen's biometric system for quantifying cervical fixations are employed in student analysis. The role of fitness training and the importance of an interdisciplinary approach to posture development are discussed along with implications for the education system and further research.

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STATEMENT OF THE PROBLEM

The Headquarters Workshop Program is an upgraded secondary special education facility for educable mentally handicapped young people aged fifteen to twenty. Many of the students have significant secondary disabling conditions. Programming emphasizes skill development in a number of practical areas as well as a lifeskills approach to academics. Students are considered as trainees; entry to the adult world of work (either paid or unpaid employment) is a goal for all.

During the 1981-82 school year, concern was expressed by staff members over a number of physical deficits observed in the students. For example:

-standing at the sink or workbench produced backache complaints,

-stirring and kneading caused wrist and arm fatigue,

-hammering and threading needles revealed difficulties in eye-hand coordination,

-bending requirements indicated limitations in flexibility,

-lifting tasks revealed strength deficits,

-attending to physical tasks for a required duration of time indicated difficulties with endurance, and

-observations of stance and gait suggested abnormalities in posture.

Concern subsequently led to a review of literature and consultation with health professionals, seeking possible directions for corrective programming.

A pilot project aimed at postural improvement was undertaken during May and June, 1982. Ten students participated in a daily regimen of conditioning exercises and awareness training for a period of six weeks. While most students did improve in specific exercise techniques, there were some who could not master exercises due to apparent skeletel problems, coordina-

tion or strength deficits. With parent and staff support, an application was made to ERIBC to undertake the present project.

The intent of this project is to explore a program aimed at the improvement of posture of secondary special needs students. It is hoped that parent and teacher information can be produced to raise the awareness level of the significant individuals who effect lives of these students. A model for the assessment of postural needs and suggestions for the rehabilitation process will be made.

BACKGROUND

Literature shows that the correction and improvement of motor functions through exercise has been around for thousands of years (Fait, 1978). The Chinese used gymnastics therapeutically some three thousand years before Christ. More recently in the nineteenth century, programs of calisthenics came in vogue as a result of medical gymnastics developed in Sweden. In the United States, corrective physical education was popular until the time of World War I. The development of physical therapy techniques during the post war eras, however, encouraged the idea of corrective exercises for students with physical handicaps while corrective physical education for general postural development of handicapped individuals was de-emphasized. While the literature may suggest that the trend today is to provide a corrective program of physical education for students needing to improve their posture, the experience of the present investigators suggests that this seldom occurs within the public school system. The Secondary Physical Education Curriculum and Resource Guide (1980) points out that for students requiring remedial programs "...an adapted program should be made available

...which not only takes into consideration the students' unique needs but also attempts to accomplish the same goals and learning outcomes as the regular programs. Such programs should only be developed with appropriate professional guidance." Similarly, the Special Education Core Curriculum Supplement (1983) reiterates that "the physical education requirements of the severely, profoundly and multi-handicapped populations will be highly individual and specialized." and continues to say that "These programs should be devised in close cooperation with involved consultative personnel, particularly the physiotherapist."

The question of "appropriate" professional guidance is of special interest in this study. Does physical education for the handicapped belong to the physical educators? Should the physical needs of special needs students be the responsibility of the special educator? Osternig (1977) suggests that "...if the responsible teacher does not establish a line of communication with associated medical personnel and parents regarding the needs of the students, the appropriateness of physical activity is generally left to speculation." The importance of an interdisciplinary approach to the rehabilitation of handicapped individuals cannot be over-emphasized. Stein (1977), however, concludes that despite great strides and progress in physical education, recreation and sports for special populations, "...too much lip service is still given to multiagency coordination and interdisciplinary cooperation; more action is needed." The present study consequently draws on the expertise of several disciplines: special education, physical education, rehabilitation, chiropractic and medicine.

The need for an interdisciplinary approach became very apparent during the 1982 six week posture training pilot project. The evaluation concluded,

in part, that

> improvement in posture, gait, coordination, strength and flexibility involves more than just educational awareness and an exercise regimen. It was evident to untrained educational staff that professional assessment and treatment is required by most students if they are to progress. Hence there is a need for more direct involvement of other health professionals dealing in this area if a posture training program is to develop.

It should be noted that the term "posture" is understood by the writers to mean good body alignment and efficient body mechanics, not just how one sits and stands.

There is a lack of literature available in the field of education relative to posture training programs or the effects of posture training upon self-concept, scholastic performance, normalization, etc., although some related information appears to exist in other disciplines. Moon and Renzaglia (1982), in a critical review of the literature relating to physical fitness and the mentally retarded concluded that "...little empirical evidence exists indicating the activities and instructional techniques best suited for this population." An article by Sherrill (1980), however, in stressing the need for posture assessment and training as an integral part of individual education program (IEP) development and the normalization process was encouraging to the authors. Similarly, several papers from the International Symposium Proceedings on "Adapted Physical Activity, Key to the Rehabilitative Process", held in Quebec in 1977, provided significant background reading.

ORGANIZATION

The Interdisciplinary Team

The interdisciplinary team approach was considered integral to the

project success. While the special educator knew her students and their parents well and understood special education methodologies, she was untrained in the area of physical education. The requirements for physical assessments and the development of appropriate exercise programs required the services of a physical education specialist. The choice of a lay professional in this discipline rather than a professional educator, was made for two reasons. Firstly, in modelling a team composition that might have transferability to other age groups more "community" involvement was sought, and secondly, the comparable equipment resources of the fitness centre were not available within the school district. The involvement of a chiropractor was solicited recognizing chiropractic leadership in spinal manipulation therapy. The medical consultant was required for consultation on project design and medical monitoring. The team was coordinated by an accredited rehabilitation worker, reflecting the role of the rehabilitation consultant in the management process.

Parent Involvement

Parents had participated in the evaluation process for the six week pilot project in 1982 and had recommended at a Parent Consultative Committee meeting that "it would be worthwhile to pursue the possibility of a longer term project in the fall that would involve school/home/chiropractic assistance." Through the same group, parent permission was solicited in making the ERIBC application. They were thereafter kept informed through school newsletters, personal contacts with staff and through project updates at Parent Consultative Committee meetings. On two occasions a chiropractic presentation was made to the parents. A parent representative observed

at all photography sessions at the team request. Parent signatures were required at several intervals: for initial participation, for release of confidential school district information, for X-ray examination and for the release of confidential medical information. Parent support was very rewarding; at no time was consent withheld.

Student Subjects

All students attending the Headquarters Workshop Program (N=12) were included as part of the experimental group (Ex). A control group (Cn) was formed by attempting to match students by age and sex with students from other secondary special education programs. This group included trainable mentally handicapped (TMH), learning disabled and slow learners. Subjects within the experimental group exhibited a broad range of specific health problems in addition to a degree of retardation, e.g. blindness, epilepsy, asthma, brain tumour, tracheotomy, Thomsen's Disease and Prader Willy Syndrome. The control group, on the whole, did not have the same frequency or severity of secondary problems. Due to constraints of time and other resources, a second control group from the regular education stream was not possible.

METHODOLOGY

Pre-Assessment

All subjects in both the Ex and Cn groups were initially assessed for baseline data in the following areas:

Fitness: body girths, skinfolds, grip strength, flexibility, aerobic capacity.

Posture: posterior stance, lateral stance, right and left lateral bending, cervical flexion/extension, cervical right/left rotation, cervical right/left bending.

Four postural photographs were taken of each of the subjects: posterior erect, lateral erect, and right and left bending.

In order to explore the relationship between manipulative skills and postural intervention strategies, all Ex subjects were tested on apparatus tests nine through twelve from the General Achievement Test Battery (GATB) designed to assess finger dexterity and manual dexterity.

Records Search

Releases were signed to allow the sharing of confidential information between the school district and health personnel, and between general practitioners and the chiropractor. Every attempt was made to review significant assessment information which was available on each student in order to eliminate potential risk factors, avoid interdisciplinary communication problems and to document each subject in a thorough fashion. Reports generally available included clinical assessments from provincial resource institutions as well as in-district agencies. Data covered medical, psychological, speech and language, physiotherapy and psychometric areas.

Fitness Intervention

All Ex subjects participated in a three month fitness intervention program conducted under the guidance of a qualified physical educator. An attempt was made to increase the overall fitness level, which was considered by the team to be very low. The program that was devised was simple

to organize and administer (see Appendix A). The objectives in each of the components were as follows:

1. strength - to increase muscle tone in abdominal, upper body and lower limb muscle groups.
2. balance - to increase muscle tone throughout the entire body.
3. flexibility - to increase range of joint movement in the trunk/hip area and increase the extent of lateral movement.
4. endurance - to increase the cardio-vascular level of fitness.
5. coordination - to increase kinesthetic body awareness by introducing multiple tasks to accomplish a particular skill.

The components were broken down into levels or a series of steps so that the participants could feel a sense of accomplishment with each measure of improvement. Also, each skill was adaptable so that everyone could participate at his/her own level. The entire program was programmed to a tape cassette of music in order to provide some rhythm and atmosphere for the approximate thirty minute sessions. The format consisted of a warm-up/loosening-up of muscles for about five minutes, a flexibility component of five to eight minutes, the main workout of about fifteen minutes and the cool-down which was about five minutes.

Post Assessment

After the fitness intervention period all Ex and Cn subjects were re-assessed with the fitness tests and the postural analysis. Results on the fitness tasks were compared with general population standards obtained from the Department of National Health and Welfare, 1978. It should be noted that although the computerized Dynavit bicycle was originally used in the

pre-assessment, the Canadian Home Fitness Test was substituted for the re-test due to the inability of the majority of the subjects to complete the test satisfactorily. General testing format conformed to the procedures outlined in the manual compiled by National Health and Welfare, with the exception of the trunk-hip flexibility measurement as this procedure was taken from the Functional Fitness Appraisal Test Manual (revised edition) by Action B.C., 1977.

Ex subjects were again photographed in the four positions identical to the pre-assessment photos. They were also re-tested with the manipulative apparatus.

Bio-Mechanical Analysis

Following the fitness intervention and post assessment, a bio-mechanical analysis was conducted. Two areas were analyzed, (a) pelvis, lumbar-thoracic spine, and (b) cervical spine.

The pelvis, lumbar-thoracic spine was analyzed using the pre and post fitness intervention photographs. Utilizing the Trotter Kinetic Posture Rating Chart individual and total scores are available at a glance to reveal bio-mechanical faults (see discussion, p. 15).

The cervical spine was assessed using a goniometer for general motion (see Figures 1, 2 and 3) and where asymetrical movement was noted a more specific X-ray study was done to establish if a correlation existed.

Bio-Mechanical Intervention

Due to constraints of time it was not possible to complete the second phase of this project, that of bio-mechanical intervention. The relationship

Figure 1: Goniometer to measure lateral bending

Figure 2: Goniometer measuring neck flexion/extension

Figure 3: Goniometer measuring neck rotation

of spinal manipulation therapy and postural effects on special needs students will continue in the fall of 1984.

RESULTS

Fitness

On a national percentile comparison the combined Ex and Cn group scored extremely low in all areas tested and placed significantly in the bottom thirty percent of the general population. Comparisons were made between the Ex and Cn groups and also between males and females. (see Appendix B)

girths - overall, little significant change was noted in any of the groups regarding girths. Any major changes were attributed to the student making a conscious effort to diet with the objective being some weight loss (this was confirmed upon questioning the students on changes noted in their measurements on the retest).

skinfolds - few significant changes were noted in this test, as students' body composition changed little. However, it should be kept in mind that adipose tissue changes take place slowly and that a three month period may be inadequate in observing significant developments.

grip strength - little change occured in this test also.

flexibility - again little or no significant change was shown in this area of trunk-hip flexibility.

aerobics - no data for aerobics is shown in this study as the computerized Dynavit bicycle was not an effective tool for measuring aerobic capacity since only twelve of the twenty-five students originally tested could complete the nine minute test. Similarly, the Canadian Home Fitness Test, which was substituted for the retest, could only assess whether the participants possessed a minimal standard of aerobic fitness based on the participants' pulse rate. A major limitation of this test is that no changes can be accurately measured on any retest. Most of the participants possessed a minimal acceptable level of cardio-vascular fitness, according to this test, but again the results are not conclusive due to the problems encountered by the tester in the course of administering the test.

It should be noted that proven testing methods were difficult to use with total accuracy. There were problems in obtaining skinfold information

in some cases because the subject's body structure was limiting. This test involved caliper measurements of the right bicep, tricep, subscapular and supra-iliac areas. Problems were encountered in both the grip strength and flexibility tests with the students not fully comprehending the verbal instructions and brief demonstration. It was felt that several students did not squeeze the Dynamometer as hard as they were capable of in accomplishing this task. In the flexibility test it was difficult to control the knee flexing which occurred. Some experienced considerable discomfort in stretching the hamstrings. "Ouch, it hurts!" was a deterrant to a few students, suggesting that pain and discomfort were either relatively unknown sensations or conversely very real forces in their lives. Also, a change of testers may have accounted for some slight data changes in these two tests. The measuring of cardio-vascular fitness, however, was the major problem in this phase of the study. The computerized Dynavit bicycle was not a satisfactory test because the participants, on the whole, could not: maintain a steady, regular pace; maintain the speed required for the heart rate to increase; maintain the pace with increased resistance; or they lacked the endurance necessary to complete the nine minute test. The Canadian Home Fitness Test, on the other hand, was not totally satisfactory either. Some participants could not maintain the rhythm; some did not have the co-ordination to step up and down correctly; and others, due to physical limitations, were unable to perform the test. The obtaining of girths (right bicep, chest, abdomen, gluteal and right thigh) was not a problem.

Manipulation Tasks

The GATB tests 9 and 10 utilize a rectangular pegboard divided into

two sections, each section containing forty-eight holes. In Test 9 the subject removes the pegs from the upper part of the board and inserts them in the corresponding holes in the lower part of the board, moving two pegs simultaneously, one in each hand (see Figure 4). The same equipment is used in Test 10. The lower section of the board contains the pegs and the subject removes a peg from a hole, turns the peg over so that the opposite end is up, and returns the peg to the hole from which it was taken, using only the preferred hand (see Figure 5).

Figure 4: Test 9
Manual Dexterity

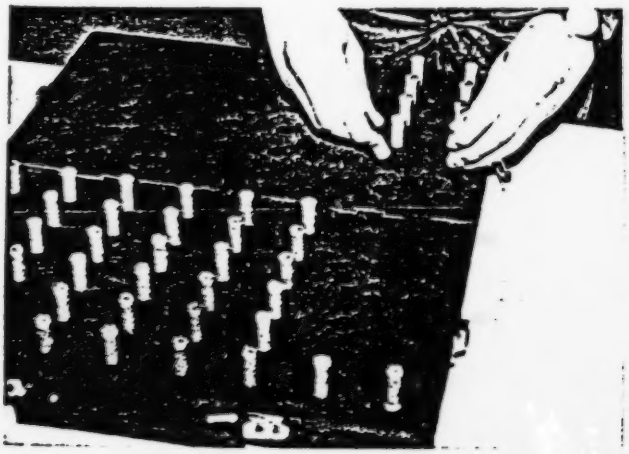
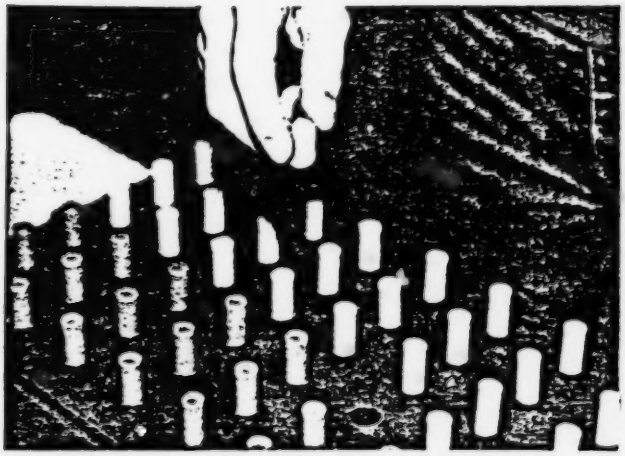


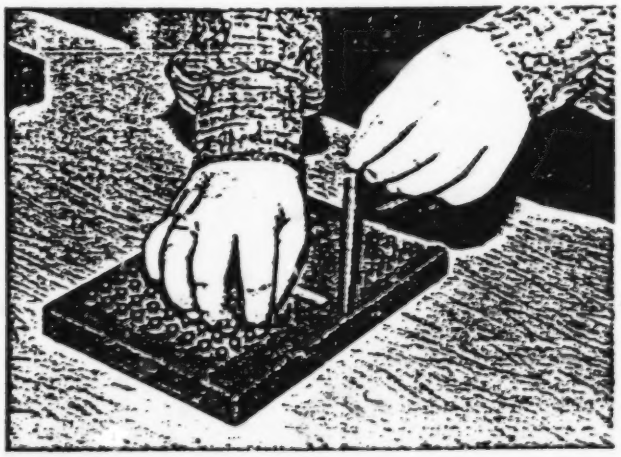
Figure 5: Test 10
Manual Dexterity



Manual dexterity is the ability to move the hands easily and skillfully. In these tests the hands are required to perform placing and turning motions.

The GATB Tests 11 and 12 are tests of finger dexterity. They assess the ability to move the fingers and manipulate small objects rapidly and accurately. The Finger Dexterity Board contains fifty holes and a supply of small rivets and washers. The subject takes a metal rivet from a hole in the upper part of the board with the preferred hand and at the same time removes a small metal washer from a vertical rod with the other hand; the washer is placed on the rivet and the assembled piece is inserted into the corresponding hole in the lower part of the board using only the preferred hand (see Figure 6). Test 12 is a reverse procedure.

Figure 6: Tests 11 and 12
Finger Dexterity



Unfortunately it was not possible to post-test all of the Ex group subjects on the apparatus tests due to illness and scheduling problems. Table I, however, gives the apparatus score results for those tested indicating the number of students altering their performance and average percentage of increase or decrease.

TABLE I

Apparatus Test Results Showing
Number of Students and the Average Percentage Gain or Loss

	Improvement	No Improvement	Total $\bar{X}$ % Gain or Loss
Test 9 Manual Dexterity	5 / 12.7%	1 / 0%	10.59%
Test 10 Manual Dexterity	4 / 13.3%	2* / -3.5%	7.7%
Test 11 Finger Dexterity	3 / 16.03%	2* / -20.7%	1.3%
Test 12 Finger Dexterity	3 / 8.92%	2* / -18%	1.84%

*One student decreased performance in all three tests

It should be noted that of the twelve test results for manual dexterity nine showed a percentage increase, two remained the same and only one showed a decrease. Only five out of the twenty-two retest scores showed a decrease in performance, while fifteen showed an increase (two remained the same).

Bio-Mechanical Analysis

The first step in the bio-mechanical analysis involved the application of the Trotter Kinetic Posture Rating System to establish if there were undetected body trunk mechanical faults. The procedure involved analysis

of the pre and post fitness photographs which had been taken in four positions: posterior erect, right and left lateral bending and lateral to the photographer. All subjects had been placed in a footplate and photographed against a double plumbline and grid. Reference points had been marked on the subjects and on the photographs: seventh cervical spinous, twelfth thoracic spinous, fifth lumbar spinous, and shoulder apices or two other symetrical points level with the seventh cervical spinous (see Figure 7).

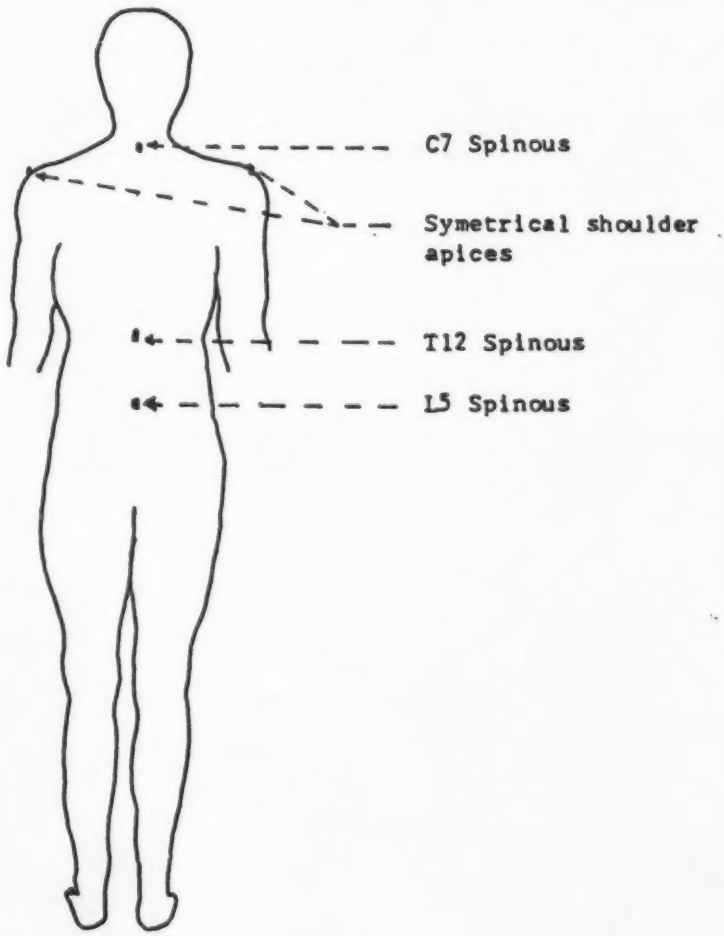


Figure 7: Spinous Reference Markings

For the lateral view the left external malleolus (ankle) and mastoid process points were used. The footplate plumbline was positioned one meter perpendicular to the grid and the photographer a further four meters away so that the plumbline and grid were aligned, as viewed with the subject in place in Figure 8. The subjects were posteriorly positioned in the footplate with the knees extended but not locked, natural stance with shoulders relaxed and head in the upright position, eyes directed horizontally forward. The lateral positioning was established by having the subject aligned to the footplate with the left malleolus used as the base centering reference point (see Figure 9). General body contours were noted for scoliosis; scapula position; pelvic, shoulder and head tilt; body sway; hip, knee, ankle and foot rotation; valgus (knock-kneed) or varum (bow-legged) positions of both ankles and knees.

Figure 8: Posterior Stance

Figure 9: Lateral Stance

Figure 10: Right Lateral Bending

Figure 11: Left Lateral Bending

The photographs revealed not only a general posture analysis but also specific areas of dyskinesis or abnormal motion. Using the Trotter Kinetic Posture Rating System involves measurement in millimeters on the three posterior views and in degrees on the lateral photographs, and recording on a nine column chart as follows:

column 1 - the total deviations right and left at L5, T12 and C7 spinous marks as measured horizontally from the plumbline reference line in the neutral erect position (see Figure 8). e.g. L5 - 2mm left, T12 - 1mm left, C7 - 4mm right, for a total score of 7.

column 2 - the millimetric score for L5 sacroiliac movement opposite to the direction of right lateral bending (see Figure 10).

column 3 - the millimetric score for L5 sacroiliac movement opposite to the direction of left lateral bending (see Figure 11).

columns 4 & 5 - the respective scores measured from the plumbline horizontally to the closest shoulder apex or other reference point previously marked.

column 6 - the anterior-posterior gravity line score measured in degrees from the plumbline to a line drawn from the ankle external malleolus vertically to the mastoid process (see Figure 9).

column 7 - the total mean difference of right and left lateral bending, columns 2 and 3, at L5.

column 8 - the total mean difference of right and left lateral bending, columns 4 and 5, at C7.

column 9 - represents the totals of columns 1, 6, 7 and 8 for a total posture measurement in static and kinetic movement analysis.

The scores are then rated as follows:

0 - 5	good
6 - 10	fair
10 +	poor

A value of 3 or more in any one column, or a total score of more than 10 indicates a need for chiropractic evaluation to determine the source of the bio-mechanical dysfunction or postural problem, i.e., foot, ankle, knee, hip, sacroiliac, lumbosacral, lumbar or thoraxic spine.

The value of this charting procedure is multifold: it objectively shows at a glance major faults of either static or kinetic nature; it can potentially be done by a lay person; many subjects can be assessed and later reviewed at a time convenient to the assessor; and a permanent record can be established for individual and group comparison. The chart scores were deemed to be significant as they revealed a consistancy of measurement and evaluation over the term of this project.

The following data from Tables II and III in conjunction with the photos is quite revealing and dictates further research as to other significant findings.

TABLE II

TROTTER KINETIC POSTURE RATING CHART

Control and Instructor Groups

Columns	1	2	3	4	5	6	7	8	9
M1	3	3	7	4	6	3	4	2	12
S1	1	0	2	1	2	2	2	1	6
S2	0	4	4	0	0	0	0	0	0
C02	6	3	0	11	2	2	3	9	20
C04	6	3	6	1	0	2	3	1	12
C06	2	4	3	0	0	4	1	0	7
C08	1	0	3	0	0	3	3	0	7
C10	5	4	1	2	1	3	3	1	12
C12	0	2	5	10	10	2	3	0	5
C14	1	0	2	0	4	1	2	4	8
C16	3	6	4	5	5	4	2	0	9
C18	0	1	2	7	7	2	1	0	3
C24	0	5	4	0	2	7	1	2	10
C26	0	0	5	7	3	1	5	4	10

TABLE III

TROTTER KINETIC POSTURE RATING CHART

Experimental Group

Columns	1	2	3	4	5	6	7	8	9
E01	3	2	0	6	4	4	2	2	11
E03	1	1	10	0	3	4	9	3	17
E05	0	2	2	10	10	1	0	0	1
E07	3	0	6	4	12	3	6	8	20
E09	9	7	5	4	0	4	2	4	19
E11	2	4	3	8	9	4	1	1	8
E13	1	1	0	0	7	1	1	7	10
E17	1	1	0	3	1	2	1	2	6
E19	1	3	5	1	1	0	2	0	3
E21	12	3	6	5	2	3	3	3	21
E23	3	0	3	4	7	3	3	3	12
E25	4	0	0	0	3	7	0	3	14

The lateral movement (columns 2 and 3) was the most revealing aspect of this study as it showed a dynamic movement beyond body sway or the body's proprioceptive adaptation to gravity, which has been the nemesis of many investigators who are only analyzing static posture (Hadden, 1983). Once a problem was found to exist by the above methodology a correlation to clin-

ical testing was established by motion palpation and orthopedic testing. In each case a definite dysfunction of either the hip joints, sacroiliac joints, lumbosacral joints or lumbar spine joints was demonstrated and is under further investigation. It is important to note that, clinically, all subjects were physically asymptomatic at the time of this investigation, which belies even more the importance of an objective screening procedure for all special needs students.

Table IV summarizes the quality of posture for all participants in this study, including the instructors (In).

TABLE IV

TROTTER KINETIC POSTURE RATING SUMMARY FOR ALL PARTICIPANTS

	Ex (N=12)	Cn (N=11)	In (N=3)
Good	1	2	1
Fair	3	4	1
Poor	8	5	1

Both the Ex and Cn groups had a high incidence of poor ratings which require professional evaluation. The instructor with the high score indicated that there was a longstanding chronic pelvic problem that required regular care.

Table V summarizes significant column scores, indicating the number of subjects exceeding the minimum standard scores.

TABLE V

TROTTER KINETIC POSTURE RATING CHART: SIGNIFICANT COLUMN SCORES PER NUMBER OF SUBJECTS EXCEEDING MINIMUM STANDARDS

	Ex (N=12)	Cn (N=11)	In (N=3)
Column 1	6	5	1
Column 6	8	7	1
Column 7	4	6	1
Column 8	8	3	0

Column 6, the anterior-posterior (A-P) gravity posture, was notably high in both groups (Ex 66%, Cn 63%) and warrants further investigation. Columns 7 and 8, right and left lateral bending, show a relatively equal grouping for pelvis-lumbar movement but a much higher factor for pelvic-lumbar-thoracic movement. This at first appears obvious due to the higher number of joints involved but the etiology factor warrants and is under further investigation. Utilizing photo analysis, it was also notable that somatotypes did not play a significant part in the overall study when motion was used as a factor in posture evaluation.

Two specific cases are presented here to illustrate the potential merit of utilizing the Trotter Kinetic Posture Rating System as a screening device for special needs students.

Case 1: Subject CO2 reveals the value of the chart and how a consistancy of measurement is retained even when foot placement was changed.

In this particular case the subject displayed a marked instability while standing with feet close together on the footplate inside position (see Figure 12). The problem arose from grossly pronated ankles. The following line chart scores show position 1 with the feet together, and position 2 when the feet are both moved laterally to the second footplate position, making the posture stance base 12 cm wider (see Figure 13).

Column	1	2	3	4	5	6	7	8	9
Position 1	6	3	0	11	2	2	3	9	20
Position 2	3	0	0	4	0	4	0	4	11

Key column scores to note are columns 1, 2, 4, 6 and 8 in position 1, and in columns 1, 2, 4, 6 and 8 in position 2. The altered scores in columns 1 and 6 reveal how a changed posture base affects static gravity position, for better or worse. Column 2, 4 and 8 scores improved with the wider base stance yet still revealed the major problem of kinetic movement being to the right hand side at the C7 reference area as indicated by the scores in column 8. This subject on physical examination displayed a marked spinal scoliosis. It is important to note that by using this type of analytical chart objective analysis can be most helpful towards physical correction. In this case the ankle pronation and the spinal scoliosis were the detectable problems and moving the posture

base wider was only one of many possible approaches to stability.

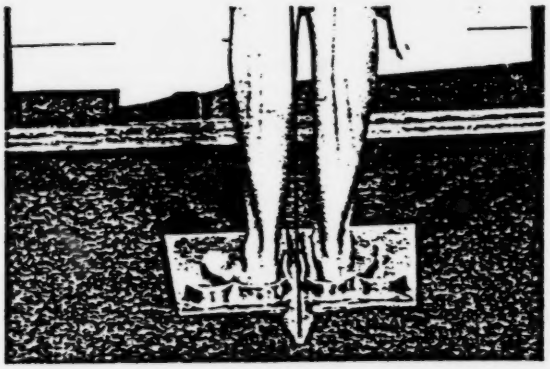


Figure 12: Footplate Inside Position

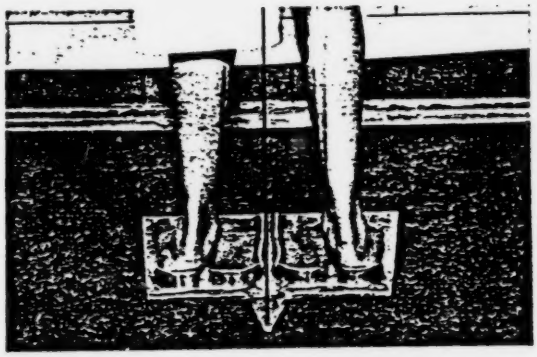


Figure 13: Footplate Outside Position

Case 2: Subject E02 (see Figure 14) was the only subject to reveal an increase in postural defect following the fitness intervention phase of this study. A comparison of the pre and post fitness intervention chart scores indicates a need for professional attention.

Column	1	2	3	4	5	6	7	8	9
Pre fitness	0	2	2	10	10	1	0	0	1
Post fitness	0	0	1	5	3	3	1	2	6

Any subtle changes of static posture as found in columns 1 and 6, which are very difficult to subjectively analyze, by this methodology reveal a worsening (column 6) and hence a potential problem. Professional intervention is desirable, therefore, before this subject should continue an exercise program. Columns 4 and 5 re-

veal an increased range of upper body motion as measured at the C7 reference point, although a slight imbalance exists.

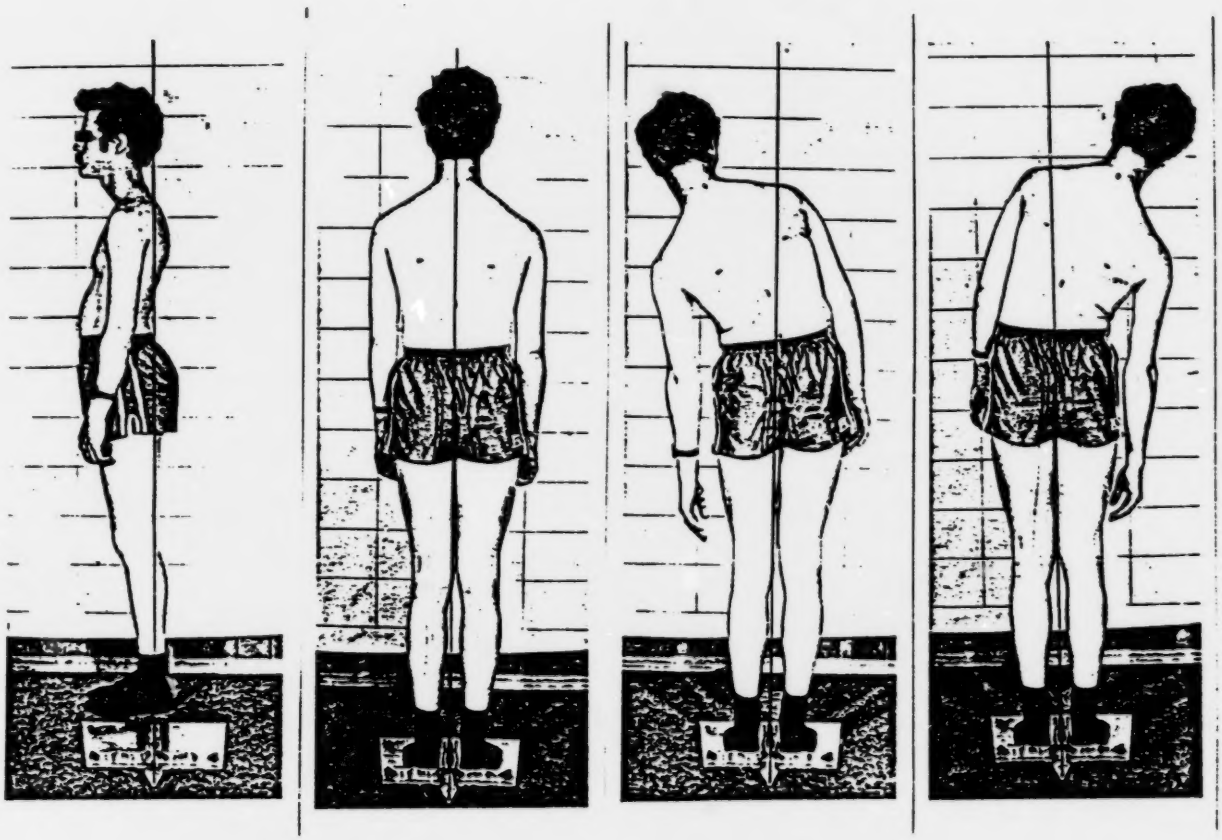


Figure 14: Subject E02 in Four Positions

In addition to the objective Trotter kinetic measurement, objective analysis of the photographs revealed many abnormalities: scoliosis, kyphosis, sway back, marked knee and ankle problems, and distorted hip and shoulder levels, all of which had been left unattended and allowed to develop to a stage of chronological physical maturity.

The second focal area of the bio-mechanical analysis was the cervical spine. This focus resulted from the high incidence of faulty position during

the initial stage of posture assessment. The first step was an objective goniometric analysis of the subjects in a seated position (see Figures 1 - 3). Head and neck movement was examined for flexion, extension, right and left lateral bending and right and left rotation movements. The basis of normal was taken as follows: lateral bending - straight to 80 degrees; rotation - straight to 90 degrees; flexion - neck flexed forward so that the chin touches the sternum; extension - touching the base of the occiput to the first thoracic vertebra (Jackson, 1966). Due to somatotype, rotation movements and lateral bending were not considered as significant a factor in this study as were the flexion-extension movements, i.e. the symmetry of motion between equal movements rather than degrees of motion was of greater interest in this study.

Table VI records the degree of cervical movement on the preassessment. Unfortunately, prior to the second examination, the Cervigon goniometer was damaged and had to be replaced with the Impairment-o-meter. For research purposes, the results were not consistant enough to assess the effect of exercise alone on head-neck motion. The initial chart did, however, reveal substantial aberrant cervical movement which established the parameters for X-ray correlation.

TABLE VI

GONIOMETER ANALYTICAL CERVICAL
MOVEMENT CHART EXPRESSED IN DEGREES

Subject	flexion	extension	right rotation	left rotation	right bending	left bending	X-ray abnormalities
M1	80	90	90	90	55	45	N.S.D.
S1	45	80	90	75	45	45	K, C1-2

TABLE VI (cont'd.)

GONIOMETER ANALYTICAL CERVICAL
MOVEMENT CHART EXPRESSED IN DEGREES

Subject	flexion	extension	right rotation	left rotation	right bending	left bending	X-ray abnormalities
S2	60	60	90	90	30	45	N.S.D.
E01	55	55	40	34	35	31	K
E03	50	90	65	62	50	42	C1-O
E05	70	50	90	90	45	45	C1-2
E07	70	70	70	54	25	40	vestigial adontoid
E09	55	90	90	90	90	90	K, tracheal vent
E11	50	60	90	70	60	50	C1-2, K
E13	55	70	90	90	38	42	C1-O
E17	80	60	82	90	65	55	N.S.D.
E19	60	90	52	52	25	35	K, C1-C
E21	90	90	63	54	28	28	N.S.D.
E25	55	55	68	58	43	35	scoliosis
C02	80	40	75	65	55	35	N.S.D.
C04	70	68	78	90	34	40	"
C06	55	90	72	62	50	44	"
C08	65	90	73	78	65	65	"
C10	52	90	90	90	39	32	"
C12	60	70	90	90	45	45	"
C14	70	50	63	64	52	35	"
C16	90	60	80	80	35	40	"
C18	80	90	63	54	60	55	"
C24	55	55	80	90	40	55	"
C26	70	60	78	72	58	32	"

Key - N.S.D. No study done
C1-O atlas-occiput approximation
C1-2 atlas axis approximation
K cervical kyphosis
Tracheal vent is an airway surgically implanted into the trachea.

It is interesting to note that in each case where motion was restricted, joint dysfunction of the cervical spine was apparent on motion palpation examination, indicating one or more spinal fixation subluxations. Again, this was noteworthy as the subjects were clinically asymptomatic as to physical impairment, i.e. the subjects did not know that they were functioning physically abnormally!

Students that demonstrated abnormality of neck flexion-extension movement were selected for X-ray examination in the sagittal plane. The reasons for examining only these subjects were: (1) the highest incidence of clinical aberration was demonstrated in these movements, (2) an objective measurement procedure is available for analysis of the kinetic movement of the cervical spine, (3) less radiation is required for this study yet maximal diagnostic information can be obtained, (4) not all subjects were available for X-ray examination due to prior radiation exposure levels (any students having radiation studies done within a one year period were excluded), and (5) an excellent cross section of somatotypes was obtained from this group.

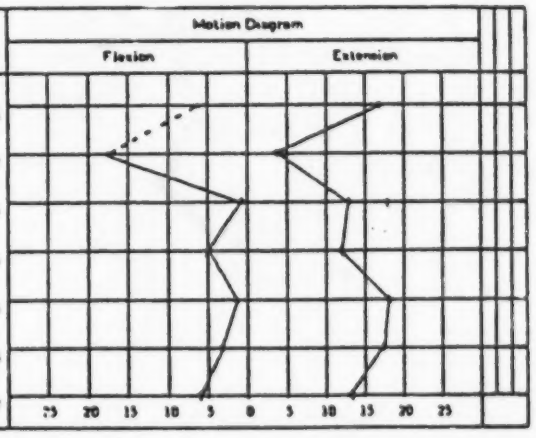
Upon initial review of the X-ray films it was startling to see so many abnormal findings in such a small population. An initial pre-screen study was performed in the neutral anterior-posterior plane and neutral lateral position. From these eleven sets of films, seven sets were chosen at random and further lateral flexion-extension studies were made. All of the eleven sets revealed gross anatomical position defects ranging from cervical kyphosis, scoliosis, combinations of the two, marked atlas-occiput approximation subluxation or atlas-axis approximation subluxation at the posterior, a permanent tracheal vent, and one subject with a rudimentary or vestigial adontoid process of axis vertebra.

Further detailed analysis of the X-rays was made following the system developed by Arlen of France for finding and quantifying cervical fixations in the sagittal plane. A detailed article written by S.F. Williams, D.C.

has been partially reproduced in Appendix C outlining this procedure.[1] Arlen's system can demonstrate fixations objectively, quantifiably and reproducibly. Suffice it for our purposes here to illustrate graphically the results of this analysis. Figure 15 contains the motion diagram of one of the instructors rated earlier as having "good" posture. It is important to note the relative symmetry in the two halves of the diagram. By contrast, the motion diagrams of six of the Ex subjects analyzed by this method are presented in Figures 16 and 17. The asymmetry of movements which can be demonstrated by this procedure become very obvious.

NAME S 1 AGE DATE

	Base Angles			Intervert. Angles			Intervert. Motion		
	Flex.	Neut.	Ext.	Flex.	Neut.	Ext.	Neut. Flex.	Neut. Ext.	Flex. Ext.
OC	34	89	166				54	77	131
C1	94	105	165	+10	+16	-1	-6	17	11
C2	32	75	132	-12	-30	-33	18	3	21
C3	33	75	119	+1	0	-13	1	13	19
C4	35	72	109	+2	-3	-15	5	12	17
C5	40	75	89	+5	+3	-15	2	18	20
C6	98	80	77	+8	+5	-12	3	17	20
C7	59	85	69	+11	+5	-8	6	13	19
							29	93	122



Data Table (After Arlen)

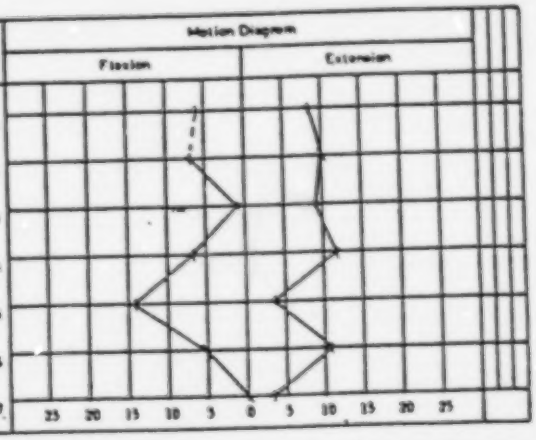
Figure 15: Cervical Motion Diagram; Instructor With Good Posture

There is some evidence of certain parallelisms between flexion and extension cervical movements. Also notable, however, are the deviations which are revealed and which correlate to spinal palpation findings as are found clinically. Again, objective methodology has confirmed the nature of postural problems in the special needs population under examination. On the other hand, the results of this bio-mechanical analysis raise a multitude of questions necessitating further research and explanation.

[1]Williams, S.F. Biometric Determination of Cervical Fixations. ACA Journal of Chiropractic. January 1984, Vol. 18, pp. 53-61. Reprinted by permission of the ACA Journal of Chiropractic.

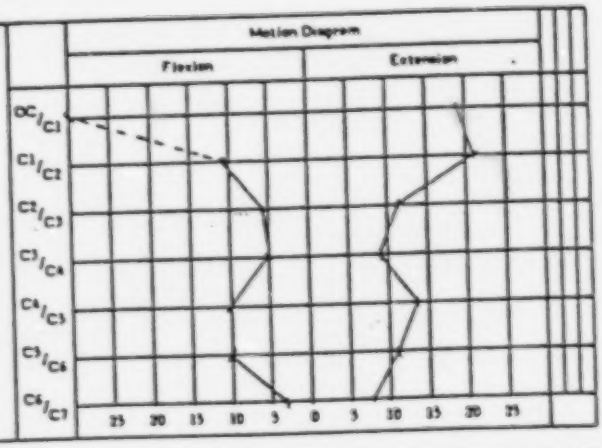
NAME E 01 AGE DATE

	Base Angles			Intervert. Angles			Intervert. Motion		
	Flex.	Neut.	Ext.	Flex.	Neut.	Ext.	Neut. Flex.	Neut. Ext.	Flex. Ext.
OC	32	87	133				55	96	101
C1	33	94	132	+1	+7	-1	-6	8	2
C2	25	79	107	-8	-15	-25	7	10	17
C3	29	82	101	+4	+3	-6	+1	9	10
C4	35	81	88	+6	-1	-13	7	12	17
C5	39	71	75	+4	-10	-13	14	3	17
C6	44	71	63	+5	0	-12	5	12	17
C7	47	68	57	+3	-3	-6	0	3	3
							26	57	83



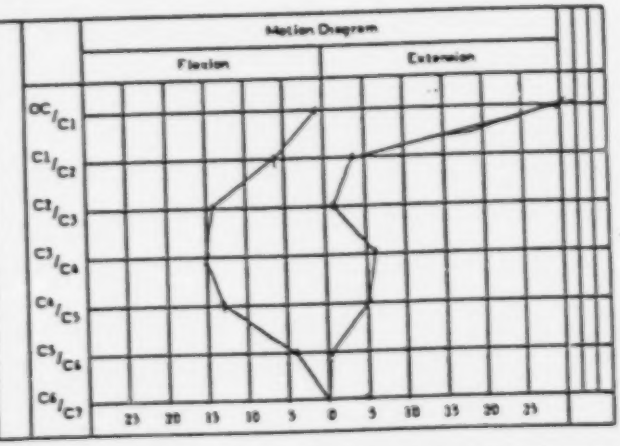
NAME E 03 AGE DATE

	Base Angles			Intervert. Angles			Intervert. Motion		
	Flex.	Neut.	Ext.	Flex.	Neut.	Ext.	Neut. Flex.	Neut. Ext.	Flex. Ext.
OC	45	82	132				37	50	87
C1	30	98	136	-15	+16	+4	-31	12	-19
C2	33	89	118	+3	-9	-19	12	9	21
C3	32	82	105	-1	-7	-13	6	6	12
C4	31	76	95	-1	-6	-10	5	4	9
C5	35	72	89	+4	-6	-9	10	3	13
C6	40	69	78	+5	-5	-6	10	1	11
C7	42	68	72	+2	-1	-6	3	5	8
							15	40	55



NAME E 05 AGE DATE

	Base Angles			Intervert. Angles			Intervert. Motion		
	Flex.	Neut.	Ext.	Flex.	Neut.	Ext.	Neut. Flex.	Neut. Ext.	Flex. Ext.
OC	39	96	148				57	52	109
C1	62	118	140	23	+22	-8	+1	30	31
C2	43	93	112	-19	-25	-28	+6	3	9
C3	42	78	98	-1	-15	-14	14	-1	13
C4	52	73	87	10	-5	-11	15	6	21
C5	52	60	69	0	-13	-18	13	5	18
C6	47	69	60	-5	-9	-9	4	0	4
C7	49	69	57	-3	-3	-3	0	0	0
							52	93	96

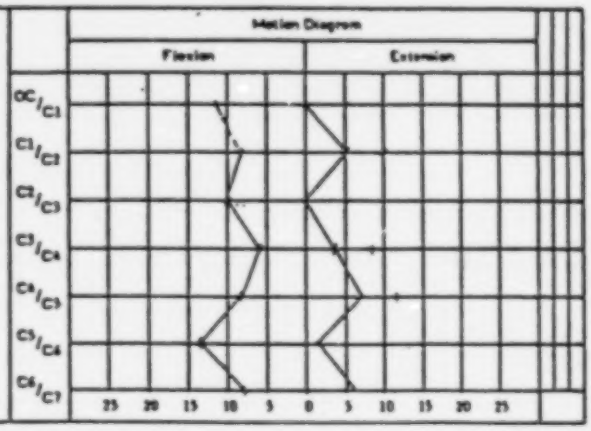


Data Table (After Arlen)

Figure 16: Cervical Motion Diagrams; Experimental Subjects E01, E03, E05

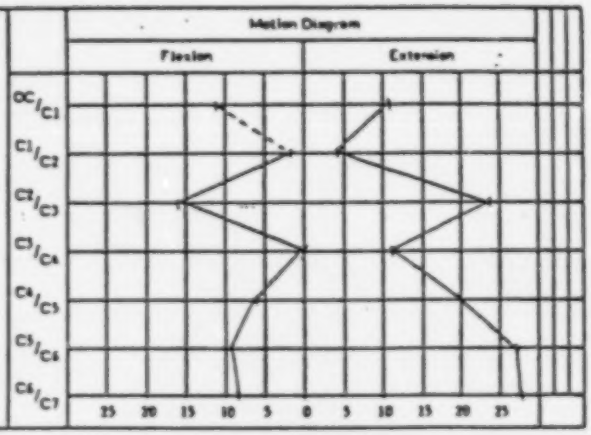
NAME E 07 AGE DATE

	Bone Angles			Intervert. Angles			Intervert. Motion		
	Flex.	Neut.	Ext.	Flex.	Neut.	Ext.	Neut. Flex.	Neut. Ext.	Flex Ext.
OC	18	90	98				72	8	80
C1	30	114	122	12	24	24	-12	0	-12
C2	24	100	103	-6	-14	-19	9	5	13
C3	25	91	94	+1	-9	-9	10	0	10
C4	29	84	84	-1	-7	-10	6	3	9
C5	22	79	67	-2	-10	-17	8	7	15
C6	36	75	70	+19	+1	+3	13	-2	11
C7	38	69	58	+2	-6	-12	8	6	14
							91	19	60



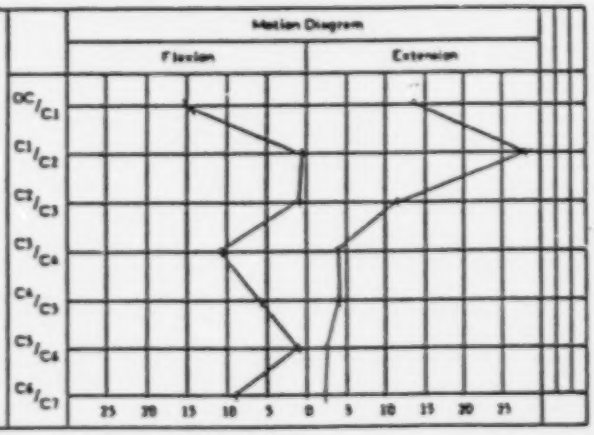
NAME E 11 AGE DATE

	Bone Angles			Intervert. Angles			Intervert. Motion		
	Flex.	Neut.	Ext.	Flex.	Neut.	Ext.	Neut. Flex.	Neut. Ext.	Flex Ext.
OC	29	76	151				52	75	127
C1	47	108	162	+23	+32	+11	-11	21	12
C2	23	82	192	-29	-26	-20	2	-6	-4
C3	22	65	120	-1	-17	-22	16	5	21
C4	20	63	106	-2	-2	-14	0	12	12
C5	29	60	90	+4	-3	-16	7	13	20
C6	36	63	79	+12	+3	-16	9	19	28
C7	48	67	60	+12	+9	-14	8	20	26
							31	89	115



NAME E 23 AGE DATE

	Bone Angles			Intervert. Angles			Intervert. Motion		
	Flex.	Neut.	Ext.	Flex.	Neut.	Ext.	Neut. Flex.	Neut. Ext.	Flex Ext.
OC	11	81	148				70	67	137
C1	21	76	130	+10	-5	-18	15	13	28
C2	22	78	104	+1	+2	-26	-1	29	27
C3	24	78	92	+2	0	-12	2	12	14
C4	31	79	79	+7	-9	-8	11	4	15
C5	32	69	65	+1	-5	-9	6	4	10
C6	30	65	58	-2	-9	-7	2	3	5
C7	29	67	57	-6	+2	-1	-8	3	-5
							27	67	94



Data Table (After Ariens)

Figure 17: Cervical Motion Diagrams; Experimental Subjects E07, E11, E23

DISCUSSION

From a bio-mechanical standpoint, posture is generally agreed to be the adaptation of an individual to his/her environment, i.e. the individual's ability to balance against gravity while standing, sitting or while in motion, in accordance with personal body type and skeletal structure. Not only are the proper alignment of body segments and the development of connective tissue strengths important, but also self-image and psychological factors bear heavily on total posture. This project has not resulted in the presentation of a model posture training program applicable to all special needs students, rather it has confirmed the need to include posture as a highly individualized part of IEP development. The concerns expressed at the beginning of this paper have raised a number of questions, many of which require further investigation. The following discussion will highlight the major areas of concern.

Fitness Training

Uninhibited and exploratory physical activity allows most young people to develop normally toward appropriate adult posture. When working with special needs students it must be recognized that, "...the potential for exercize to restore function or ameliorate pathological conditions is limited. Where existing conditions are a result of muscle imbalance or weakness, exercize can play a significant role in rehabilitation. However, the use of exercise to influence structural deviations is generally worthless and may be deleterious if its use delays appropriate treatment" (Osternig, 1977). General fitness training, as conducted in this study, does have value for the special needs population. Students who have come through the special education continuum from the elementary school may never have had the op-

portunity to participate in a regular program of fitness training. As evidenced in this study, not only are basic skills lacking, but also carry-over activities such as jogging, hiking or calisthenics. While most special needs students have the opportunity to participate in leisure sports activities, the program emphasis is frequently of a social and recreational nature. The fact that the Ex and Cn groups both fell in the bottom thirty percent of the population by National Health and Welfare standards suggests a need to re-examine physical education programming for special needs students. Whether the lack of a fitness program for special needs students is due to limitations imposed by their handicaps, or because the students are perceived to be incapable of participating in physical activity in many cases is a moot point. The lack of availability of qualified and interested physical educators and access to equipment and facilities may be a more limiting factor.

It should be noted that fitness training can be a significant factor in weight control. Obesity is recognized as a common problem among the adult mentally handicapped, which can affect their quality of life. Rarick and McQuillan (1977) found that mentally retarded adolescents "...generally possess a greater percentage of body fat than normal individuals the same age and sex." Coyne (1980), in discussing leisure activity and weight control makes reference to the work of Bailey (1978) in saying that many exercise laboratories have shown that "...a steady continuous exercise repeated every day reverses the syndrome of making excess fat more quickly than any other kind of exercise. Aerobic exercise is the most efficient way to remove the marbling fat and additionally changes the metabolism so that it will not make so much fat."

It was encouraging that the students perceived the fitness training

to be fun. Staff exercised with students and charts were maintained visibly in the hallway with achievement levels indicated by colored stars. Students became more aware of the need for personal fitness and were challenged to improve their individual performances. The fitness training phase of this project achieved very gratifying responses from the students; there was a sense of motivation and accomplishment. In the opinion of the writers, general fitness training is concomitant to good posture and should be part of any posture training program.

Fine Motor Training

Many handicapped young people will graduate to sheltered workshops or activity centers where they will do assembly work, needlecraft, weaving, ceramics or some other similarly sedentary activities requiring fine motor skills. Any assumption that students will naturally learn fine motor skills, given time, is disconcerting. If mentally handicapped young people developmentally lag behind the rest of the population then curriculum should reflect the need for continued attention to both gross and fine motor developmental tasks. Fine motor training requires small muscle movements of the fingers, hands and forearm and implies eye-hand coordination. Specific methodologies for manipulative skill training need further investigation. Literature shows that the motor ability of the mentally handicapped can be improved with appropriate programming. Stein (1977), after analysis of almost 900 studies, points out, in part, that "fine motor skills appear to be an important attribute in developing vocational skills that can be used in sheltered workshops or in jobs per se." While the sample of students doing the apparatus re-test was small, the results do suggest a possible relationship between general fitness training and manual dexterity, finger dexterity

and eye-hand coordination. Continued efforts specifically directed toward improving fine motor performance seem warranted.

The Trotter Kinetic Posture Rating System

The Trotter Kinetic Posture Rating System introduced in this study is an important methodology with consistancy of analysis that has potential value in clinical and non-clinical settings. It has the potential to be employed by a lay person or educator, with minimal training, yet provide objective information of bio-mechanical dysfunction. Used with professional consultation, it may serve as a useful screening device for special needs students in need of therapeutic intervention. Continued validation needs to be done in this area.

Subjective Symptamatology

In as much as all subjects participating in this study were clinically asymptomatic, the question of advocacy and responsibility is raised. It is hypothesized that special needs students as a group are less able and less likely to express subjective symptamatology. Those with a disability that is congenital or acquired in infancy may have no comparison for the stress within their own system; those coming from deprived home and social environments may not have the awareness of professional resources available to them; those with limited intellectual capacity or inadequate communication may not be able to express the discomfort in their bodies. Where does our moral responsibility lie in relieving the dis-ease within the bodies of the handicapped? Does the high incidence of postural abnormalities found in this study warrant the introduction of postural screening programs?

Cervical Dyskinesis

The Arlen approach to finding and quantifying cervical fixations in the sagittal plane is a procedure new to North America. The objectivity of this analysis is encouraging. The findings relative to dyskinetic cervical motion are significant enough to warrant further testing in comparison to the general student population. It is hypothesized that further investigation will show a higher percentage of cervical fixation amongst the special needs population. If substantiated, a host of questions relating to the possibilities of early intervention strategies arise. The need for continued research in this area with younger subjects will become apparent.

X-Rays

Recognizing and accepting the norms for radiation levels and based on the high incidence of abnormality found in the Ex subjects, particularly with reference to the finding of one student with a rudimentary or vestigial adontoid process of axis vertebra, adequate X-ray examination is essential for continued posture research with special needs students. In the absense of clinical information provided by X-ray examination, spinal manipulation therapy could be potentially at risk for special needs students.

Bio-Mechanical Intervention

Given the objective data available on the Ex subjects at this point, continued research into bio-mechanical intervention is a logical follow-up. A host of questions now arise: Are the aberrant patterns changeable? Are they transitional or of chronic or acute term? To what degree are they relatable to specific task performance? Is there any relationship to neurological function? Can intervention affect hyperactivity, nervousness,

irritability, etc.? Can self concept be increased? Some of these questions are under further investigation.

Work Site Implications

Given the nature of the training program offered at the Headquarters Workshop, i.e. a transition to the world of work, it seemed important to include a brief worksite examination in this project. The material presented here is simply observational, but in the opinion of the writers, warrants further investigation.

(a) Installation Standards. According to the School Building Manual (1967) there are prescribed installation standards for cooking lab and shop facilities. Bench and counter heights range from thirty to thirty-six inches, depending on their use. The same standards apply to all students. Figure 18 illustrates the difference in posture for two students working at the same bench. This situation could occur in regular education as well as in special education. How many readers have known an adult to complain of backache or fatigue while standing at a counter, table or bench? Should students be taught coping strategies to accommodate their physical differences? Do instructors have the knowledge that is required in this area?

(b) Safety. Again, Figures 19-22 illustrate potential safety concerns where there is a significant height differential when using power machinery. When working surfaces are constant, height dictates stance, control over the work and proximity of the face to the

Figure 18: Posture Comparison at Workbench

cutting edge. (Note: photographs were posed; face shield protection is required when equipment is in operation.) The three year spread in age between these two students can be found in any junior or senior secondary school. While safety orientation is part of any shop training program, a solid safety education program is particularly important for special needs students. While it may be easy to say that a paraplegic in a wheelchair cannot operate a radial arm saw, it is a judgement call by the instructor when it comes to the TMH, EMH or someone short of stature. Are shop teachers adequately prepared for the safety education needs of special needs students?

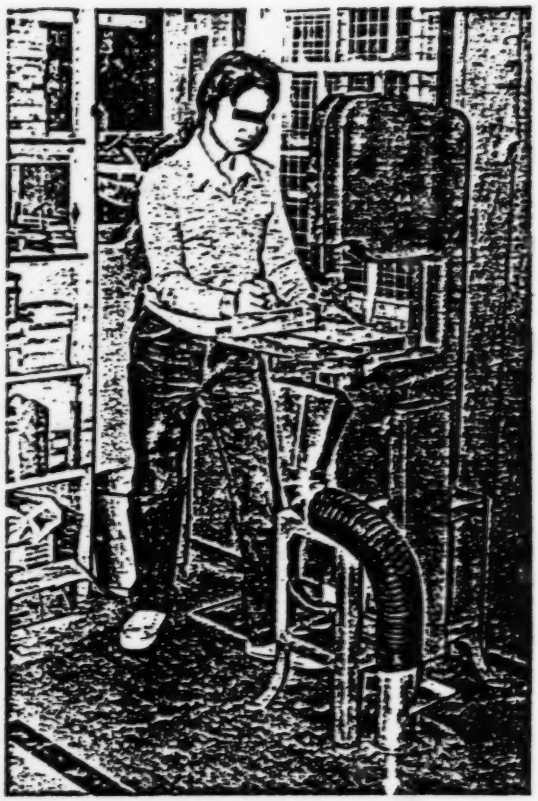


Figure 19: Taller Student at Bandsaw

Figure 20: Shorter Student at Bandsaw

Figure 21: Taller Student at Radial Arm Saw

Figure 22: Shorter Student at Radial Arm Saw

(c) Site Modifications. Industry and labour are aware of the need for work site modifications. Is education abreast of the programs available to assist in modifications and is the necessary guidance and counselling provided for students requiring assistance? While site modifications are most common for the blind and the physically disabled, are there ways to be assisting the mentally handicapped to be working in a safer environment?

(d) Self Understanding. If self awareness training is not part of a curriculum, or if there is no advocacy and there are only minimal academic skills, young people will not have the personal awareness regarding potential posture related problems. Awareness of personal body stress management can aid the handicapped to successfully cope with stressful work situations. Specific physical needs should also be addressed through the IEP.

Since time in the workplace accounts for the major portion of an adult's daily routine, familiarizing the handicapped with work site implications is important.

Interdisciplinary Team

This project has generated many questions as it has progressed. The need to pool available knowledge has been obvious to the writers. It is not enough to simply understand the nature of exercise and physical activity; it is vital to understand the nature of the handicaps and their affect on the learning process. Not having the advantage of educators specializing in corrective and adaptive forms of physical education, make even more imperative the team approach. The value of having someone trained in joint

dysfunction analysis has been integral to this project. The union of educators and health personnel should be a natural one. The involvement of the general practitioner and the chiropractor, as evidenced in this study, are critical in the rehabilitation process where there are posture concerns. The many physical defects revealed by this study emphasize that early intervention by knowledgeable health professionals is essential. While rehabilitation itself is a relatively new discipline, it provides optimism for the coordination and syntheses of services and programs for the handicapped.

SUMMARY

This project has attempted to explore the relationship of fitness training to posture development and has presented a system for bio-mechanical analysis that can be useful in assessing the postural needs of special education students. Continued research and validation of procedures and results are needed. Many questions, hopefully of interest to educators and health personnel, have been raised.

GLOSSARY

aberrant motion - a variation from normal motion.

Atlas vertebra - first cervical vertebra.

Axis vertebra - second cervical vertebra.

C-7 - seventh cervical vertebra.

Dyskenetic motion - impairment of the power of voluntary motion.

Kyphosis - a posterior curve of the spine (abnormal - hunchbacked).

L5 - the fifth lumbar vertebra.

motion palpation - palpation whilst moving parts of the body.

Occiput - the base bone of the skull.

palpation - the laying of the hand on the body to ascertain its condition or that of underlying organs.

Scoliosis - lateral curvature of the spine.

Spinous Process - that part of the vertebra which is perceived as bumps in the midline of the back on trunk flexion.

Subluxation - a pathological situation in which there is not a normal physiological juxtaposition of the articular surfaces of a joint or movement.

Sagittal - anteroposterior median plane of the body.

APPENDIX A

Fitness Training Program

WARMUP:

Walk on the spot	- 20x
Continue walk and deep breaths	- 10x
Swing right arm	- 10x
Swing left arm	- 10x
Swing both arms together	- 10x
Light bounces - feet on ground but use knees	- 10x
Light bounces - feet leave ground	- 10x
Light bounces - use toes for spring action	- 10x
Arms in, arms out to sides	- 15x
March on spot, lifting knees up	- 20x
Marching, touch palms with knees at waist	- 20x
Kick feet out forward, starting low	- 10x
Kick feet out forward, about hip height	- 10x
Knee circles - to right and to left	- 10x each way

STRETCHING:

Elbow circles - forward right and left arms	- 5x each
- backward	- 5x each
Trunk twists - keep elbows above shoulders	- 5x each
Side stretch - hand behind head with elbow pointing to ceiling	- 5x each
Sit and Reach - knee slightly bent	- 3 to 5x each
Hip twist	- 3 to 5x each
Knee to chest pull	- 3 to 5x each
Heel stretch on back - heel points up	- 3x each
Curl and stretch	- 5x each
Skier stretch - hands stay on floor always	- 5x each

MAIN WORKOUT:

SITUPS:	Level 1 - feet held	- 10x
	Level 2 - feet unsupported	- 10x
	Level 3 - twist situps	- 10x per side
	Level 4 - knee to elbow situps	- 10x per side
	Level 5 - crunches	- 10x

CO-ORDINATION: Level 1 - 2 log rolls to left
2 log rolls to right
Level 2 - squat thrusts (burpees) - 10x
Level 3 - jumping jacks - 20x
Level 4 - alternate burpee with situp - 10x
Level 5 - alternate jumping jack with burpee - 10x

PUSHUPS: Level 1 - wall pushups - 10x
Level 2 - knee pushups - 10x
Level 3 - full pushups - 10x (boys)
- 5x (girls)
Level 4 - inverted pushups - 10x (boys)
- 5x (girls)
Level 5 -

LEGS: Level 1 - part squats by chair - heels are on board - 20x (boys)
- 15x (girls)
Level 2 - step up and down bench, feet alternating (can use hand support) - 50x (boys)
- 35x (girls)
Level 3 - leg changeovers on bench with feet alternating (hand support O.K.) - 50x (boys)
- 35x (girls)
Level 4 -
Level 5 -

BALANCE: Level 1 - bounce on left foot and then right foot (hands on hips) - 10x per side
Level 2 - stand on tip-toe, hands in front at shoulder height, with feet together doing $\frac{1}{4}$ squats - 10x (boys)
- 7x (girls)
Level 3 - 2 foot bounce in and out of circle - 10x
Level 4 - 1 foot bounce in and out of circle (both left and right) - 10x each (boys)
- 6x each (girls)
Level 5 -

ENDURANCE: Level 1 - run on spot (50x/right foot touching) OR jumping jacks 30x
Level 2 - run on spot (75x/right foot touching) OR squat thrusts 20x
Level 3 - run on spot (125x/right foot touching) OR sprinters exercise 30x/right foot)
Level 4 - run on spot (200x/right foot touching) OR run on spot with knees touching palms (75x/right foot touching)
Level 5 - run on spot (300x/right foot touching) OR rollback to star jumps (25x - boys) (20x - girls)

COOLDOWN:

side stretch	- 5x each
sit and reach	- 3x each
prone leg lifts	- 5x each
straddle toe touches	- 3x each

Equipment:

Ropes
2" x 4" blocks about 12" to 18" long
chairs
low stable bench
tape recorder for music
mats or some sort of padding on floor

Points to remember:

MAINTAINING MOVEMENT IS "THE KEY" - if someone cannot keep going, encourage that person to keep walking: don't just sit down and stop cold.

ENTHUSIASM & ENCOURAGEMENT ARE ALWAYS WELCOME AND DO WONDERS FOR A TIRED BODY (or a reluctant participant).

TRY TO DO TESTING ON A ONCE-WEEKLY BASIS

APPENDIX B

Fitness test percentiles based on a comparison with chart from the Department of National Health and Welfare

		Above 50%	30-49%	0-29%
Skinfold				
	Female			
	Cn Test 1 (N=6)	1	0	5
	Cn Test 2 (N=7)	2	1	4
	Ex Test 1 (N=7)	1	0	6
	Ex Test 2 (N=7)	2	1	4
	Male			
	Cn Test 1 (N=5)	4	1	0
	Cn Test 2 (N=7)	6	1	0
	Ex Test 1 (N=7)	2	1	1
	Ex Test 2 (N=7)	3	1	0
Grip Strength				
	Female			
	Cn Test 1 (N=8)	4	2	2
	Cn Test 2 (N=7)	3	1	3
	Ex Test 1 (N=8)	4	1	3
	Ex Test 2 (N=8)	4	0	4
	Male			
	Cn Test 1 (N=5)	1	1	3
	Cn Test 2 (N=7)	3	2	2
	Ex Test 1 (N=4)	0	0	4
	Ex Test 2 (N=4)	1	0	3
Flexibility				
	Female			
	Cn Test 1 (N=8)	3	1	4
	Cn Test 2 (N=7)	4	0	3
	Ex Test 1 (N=8)	4	1	3
	Ex Test 2 (N=8)	4	0	4
	Male			
	Cn Test 1 (N=5)	0	0	5
	Cn Test 2 (N=7)	2	0	5
	Ex Test 1 (N=4)	2	0	2
	Ex Test 2 (N=4)	1	0	3

APPENDIX C

Biometric Determination of Cervical Fixations

By Samuel F. Williams, D.C.

Dr. Samuel F. Williams

Licensed to practice in Virginia and West Virginia, Dr. Williams holds bachelor's and master's degrees from the University of Colorado and is a 1978 magna cum laude graduate of Palmer College. After a brief associateship in Virginia following graduation, Dr. Williams moved to Europe and is now practicing at Nymphenburger Strasse 84, 8000 Munich 19, West Germany.

A biometric system, developed by Arlen of France for finding and quantifying cervical fixations in the sagital plane, is described. Claims made for the system are discussed as well.

Spinal Manipulative Therapy (SMT) rests generally on the theory that vertebral syndromes derive from functional disturbances of the intervertebral joints. Its *raison d'etre* is seen in its ability to affect functionally disturbed joints in such a way as to eliminate or reduce pain and restore normal physiology in the affected joints and neighboring and reflexly-related distant soft-tissue.

A frequent charge leveled at practitioners of SMT, be they chiropractors, osteopaths or medical manipulators, is that functional disturbances of the spine (subluxation, manipulatable lesion, osteopathic lesion, etc.) cannot be objectively demonstrated. Static and motion palpation, while undeniably a valuable examination tool, is susceptible to a certain degree of subjectivity and most of the systems of radiographic line drawing designed to detect functional disturbances have to be accepted on faith. Two notable exceptions are the methods designed by Sandoz[1] and Hviid.[2]

Additionally, it is argued, even if spinal functional disturbances could be objectively demonstrated there is no way to prove a causal relationship between them and vertebral syndromes. The conclusion is then, our critics contend, that SMT is not a valid, effective therapy.

It was with a great deal of interest then, that I read the work by Arlen[3] of France. In this work Arlen, an allopath and long-time practitioner of SMT, presents a system for measuring motion of the cervical spine in the sagital plane. This system, he claims, can demonstrate fixations objectively, quantifiably, and reproducibly (in the sense that two or more observers would find the identical deviations). Moreover, he claims that his system can illustrate the causal link between fixations and vertebral syndromes. Fixations are, after all, a cardinal component of the manipulatable lesion.

Because this work has not yet been translated into English (the author has been in contact with Arlen) and because it is of potential value, I will present here its essence and briefly discuss its possible applications (those interested in more in-depth description are referred to the original work).

The Arlen method requires the usual three lateral views — neutral, flexion, and extension. On positioning the patient, care is to be taken to avoid rotation and lateral bending of the patient's head. The patient is to relax and drop the shoulders to ensure inclusion of C7 on the film. Additionally, on flexion and extension the patient is to avoid, as much as possible, movement in the thoracic spine.

The following series of lines is to be placed on each of the films:

1. *McGregor line.* A line tangential to the base of the occiput and

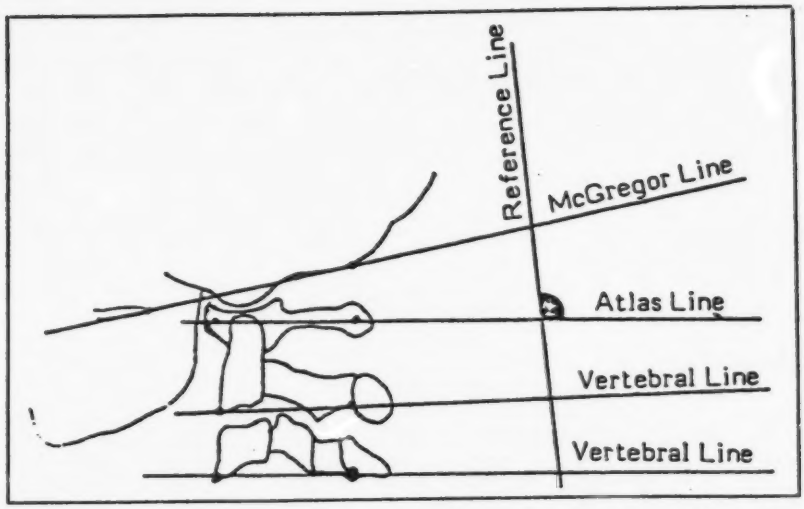


Figure 1: Required lines (After Arlen)

extending through the posterior aspect of the hard palate (Fig. 1).

2. *Atlas line.* A line extending through the middle point of the anterior arch of atlas and the middle point of the oval projection of the posterior arch (Fig. 1).

3. *Vertebral lines* (C2 through C7). A straight line extending through the anterior-inferior margin of each vertebral body and through the posterior-inferior margin of each vertebral body and through the posterior-inferior margin of the vertebral canal (Fig. 1). In the presence of morphological alteration, e.g. osteophytosis, where the usual points for the vertebral lines cannot be located, these points should be approximated. The important thing in such cases is that the same point be used on all three views.

4. *Reference lines.* One or more vertical lines as needed drawn parallel to the film edge bisecting the above lines (Fig. 1).

The next step consists in measuring the upper right angle formed by the reference line bisecting the other lines. This produces eight angles per film for a total of 24. These angles, designated base angles, are entered into the first three columns of the data table illustrated in Fig. 2.

The third step produces intervertebral angles, i.e. the angles formed by each two neighboring vertebral lines, including the McGregor and atlas lines. Unlike the base angles, these angles are not read directly because they are, depending on the attitude of each vertebra, relatively small, cumbersome to measure, and accordingly, susceptible to inaccurate readings. Rather, they are derived from the base angles. This is accomplished by subtracting, in the first three columns, each base angle from its subjacent base angle, starting with OC from C1, C1 from C2, etc. The difference corresponds to the intervertebral angle of each two neighboring intersecting vertebral lines (proof is the exterior angle theorem). These values are entered into columns 4 through 6 of the data table. Computation of the intervertebral angles may yield both negative and positive values. Negative values indicate opening of the intervertebral angles anteriorly, while positive values indicate opening posteriorly. A zero value indicates two parallel lines.

The fourth step of the system consists in deriving from the intervertebral angles, the degree of motion of the individual vertebra in the sagital plane. This motion is a horizontal shifting and rotation about the frontal axis and is manifested by the change in angle between every two neighboring vertebral lines as the head moves from one position to another, i.e. from neutral to flexion and from neutral to extension. Thus, from the values in columns 4, 5, and 6 we derive the values for columns 7, 8, and 9. To derive the total excursion of each segment from flexion to extension, we simply add the two values for flexion and extension (see Fig. 4).

Columns 7, 8, and 9 of the data table provide the following data:

a) The excursion of each segment (C1 through C7) from one end position to the other, i.e. from flexion to extension;

b) Partial excursion of each segment (C1 through C7) from neutral to flexion and from neutral to extension;

c) Total flexion of the cervical spine (sum of all the values in the neutral-flexion column);

d) Total extension of the cervical spine (sum of all the values in the neutral-extension column);

e) Total mobility of the cervical spine in the saggital plane (sum of all the values in the flexion-extension column). An additional measure for total movement of the cervical spine can be found in the total excursion of the occipital (McGregor) line. The differences between the McGregor line base angles (neutral-flexion and neutral-extension) are added to obtain this measure. In Fig. 4 this is 115° in the uppermost space of column 9.

Arlen briefly describes what he calls a paradoxical atlas tipping or atlas inversion. Normally, on flexion the space between the posterior-arch of atlas and the base of occiput becomes greater. On occasion the opposite occurs, with the occiput and atlas approaching each other posteriorly on flexion. This phenomenon, according to Arlen, is seen more often in young patients with good cervical motion and does not indicate a fixation. So, on mathematical grounds, when

Figure 3: Flexion ~~Extension~~

this motion is encountered, the value in column 7 on the C1 line is entered as a negative and then subtracted from column 8 to obtain column 9. Normally columns 7 and 8 are added to obtain column 9.

Next we move to the far right side of the data table to the section designated "motion diagram" which is a system of co-ordinates. The motor unit level is found on the ordinates and the degree of motion on the abscissa. Data from column 7 are plotted to the left of the zero line and data from column 8 to the right. In cases of atlas inversion, a dotted line instead of the usual straight line is used, connecting the OC/C1 and C1/C2 levels. This is really the business end of the data table for at a glance it shows at what level(s) there are fixations, reduced mobility, and unequal movement between flexion and extension.

Fig. 3 contains a set of functional cervical radiographs from my practice with all lines drawn, and Fig. 4 illustrates a completed data table with values from these radiographs.

Arlen sees his system of functional analysis as having two practical applications: as an examination tool in individual cases; and as a tool for SMT research. . . . . .

NAME AGE DATE

	Base Angles			Intervert. Angles			Intervert. Motion		
	Flex.	Neut.	Ext.	Flex.	Neut.	Ext.	Neut. Flex.	Neut. Ext.	Flex. Ext.
OC									
C1									
C2									
C3									
C4									
C5									
C6									
C7									

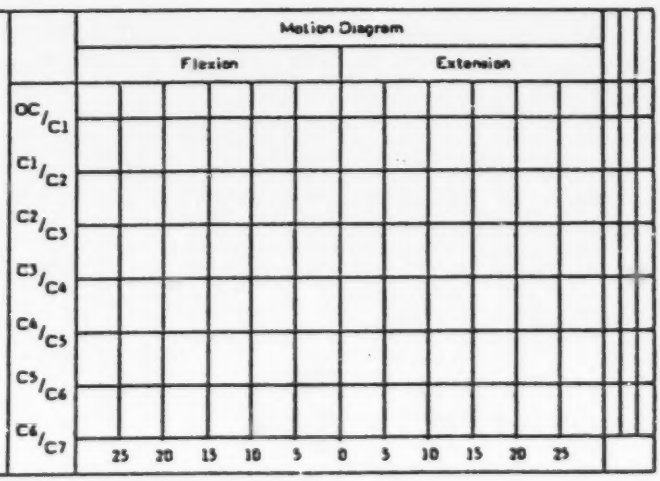


Figure 2: Data Table (After Arlen)

Figure 3: Extension

in the upper cervical joints, while motion at C3/C4, and C5/C6 was significantly less among the patient group; in the headache studies the number of individuals without fixations was approximately equal in both groups, while multiple fixation was twice as frequent in the headache group and upper cervical movement was less among the headache patients; in the cervicocephalalgic studies both groups exhibited more or less overall equal movement, but the patient group showed unequal movement between extension and flexion, i.e. flexion may be normal while extension is generally decreased, or vice-versa.

As a tool for SMT research Arlen applies his system to statistical comparison of large groups. Here his interest has been in showing that a regularly occurring pattern of functional deviations exists along with specific symptom pictures, or, in other words, that there are syndrome-specific functional disturbances.

Arlen's work presents 24 individual case studies of clinical entities including torticollis, brachialgia, shoulder-arm syndrome, various types of headache, and Barré-Liéou syndrome. Several asymptomatic cases were shown to illustrate the "normal" data table. Functional studies were prepared on all cases and post-therapy studies were carried out in the majority of cases. Good abatement of symptoms and improved function were seen in almost all cases.

In this writer's opinion, these case studies constitute the weakest aspect of Arlen's work. He mentioned nothing about the nature and frequency of the treatment delivered. One would assume, of course, that he used SMT. But what type of techniques, at what intervals, were used, and what was the total number of adjustments or manipulations? The question also arises that Arlen, being an allopath, may also have applied the traditional allopathic treatments such as analgesics, antispasmodics, physiotherapy, massage, exercises, and traction. Without this information much of the wind is taken from his sails. Additionally, his post-studies were generally done one to two years later. With such a lengthy time-lapse, the possibility of self-limitation enters the picture.

The statistical group studies, in this writer's view, more cogently back Arlen's claims for his biometric system. Three studies are included: a control group of 73 individuals is compared with 73 patients that presented with shoulder-arm syndrome; a control group of 100 is compared with 136 headache patients, and 80 controls are compared with 100 cervicocephalalgic patients. The results, essentially, are as follows: In the shoulder-arm studies both groups had more or less equal movement

Although Arlen employs his biometric system routinely and has applied it to more than 9,000 cases to date, this writer does not use it with such frequency. Its use subjects the patient to greater radiation exposure and financial burden and places demands on the limited time of office personnel (approximately 30 minutes are required to perform the analysis). In cases, mainly trauma, where functional studies are routinely done, we apply the Arlen system. For whatever it's worth, my palpation findings so closely correlate with the findings from the Arlen system as to render it superfluous as a routine examination tool. Its greatest potential value, in this writer's opinion, lies in the area of research. An ideal setting, perhaps, is our school clinics, where large numbers of patients are seen and abundant personnel are available to perform the analysis. At any rate, the system deserves a good investigation and could conceivably become a valuable tool in the process of corroborating what we chiropractors have long known and see daily in our practices. ■

Figure 3: Neutral

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NAME AGE DATE

	Base Angles			Intervert. Angles			Intervert. Motion		
	Flex.	Neut.	Ext.	Flex.	Neut.	Ext.	Neut. Flex.	Neut. Ext.	Flex. Ext.
OC	27	90	142				63	52	115
C1	42	108	145	+15	+18	+3	-3	15	12
C2	28	87	115	-14	-21	-30	7	9	16
C3	32	82	109	+4	-5	-6	9	1	10
C4	38	79	100	+6	-3	-9	9	6	15
C5	39	71	84	+1	-8	-16	9	8	17
C6	48	69	68	+9	-2	-16	11	14	25
C7	47	55	54	-1	-14	-14	13	0	13
							55	53	108

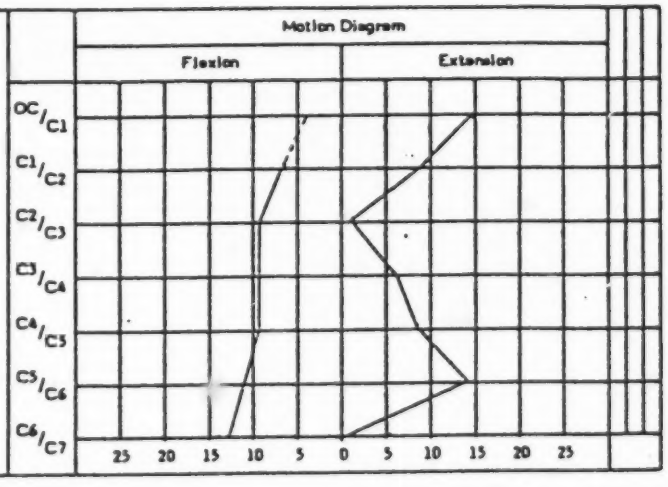

Figure 4: Completed Data Table

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